a sensing assembly to measure manipulation of said captured peripheral and transmit information associated with said manipulation to the simulation system to simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation.

86. The apparatus of claim 85 wherein said medical instrument includes an endoscope.

87. The apparatus of claim 85 wherein said peripheral includes a nested instrument assembly, and said interface apparatus further includes:

a plurality of capture mechanisms each engaging a corresponding instrument of said instrument assembly to enable said interface apparatus to measure manipulation of that instrument; and

a plurality of sensing assemblies each measuring manipulation of a corresponding captured instrument of said instrument assembly.

88. The apparatus of claim 85 further including a pivoting mechanism to pivot said orifice.

89. An interface device for interfacing instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface device comprising:

a plurality of peripherals in the form of mock medical instruments capable of selective manipulation by the user;

a plurality of orifices for receiving said instruments;

a plurality of guide tubes for directing said instruments from said orifices into said interface device;

a plurality of capture mechanisms for engaging said instruments to enable said interface device to measure manipulation of and provide force feedback to said instruments; and

a plurality of sensing assemblies to measure manipulation of and provide force feedback to said instruments, wherein each said sensing assembly includes:

motion detection means to measure manipulation of a corresponding captured instrument and provide signals indicating said measured manipulation to said simulation system to simulate said medical procedure; and

force application means to apply force feedback to said corresponding captured instrument in response to control signals from said simulation system.

90. The device of claim 89 wherein at least one of said instruments includes a nested instrument assembly.

91. In an interface apparatus for operatively interconnecting a peripheral corresponding to a medical instrument to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, wherein said interface apparatus includes a sensing assembly to measure manipulation of said peripheral and transmit

information associated with said manipulation to the simulation system, a capture mechanism for engaging a peripheral inserted within the interface apparatus to enable the interface apparatus to measure manipulation of that peripheral, said capture mechanism comprising:

a grasping member for engaging said peripheral to enable said interface apparatus to measure manipulation of said peripheral; and

an actuator for activating said grasping member to engage said peripheral in response to manipulation of said peripheral into said grasping member.

92. In an interface having a peripheral selectively manipulable by a user and corresponding to a medical instrument and a sensing assembly to measure manipulation of the peripheral, a method of enabling the user to interact with the simulation system, via the interface, to perform a medical procedure on a simulated anatomy of a virtual patient comprising the steps of:

(a) inserting the peripheral into said interface via an orifice, and selectively manipulating said peripheral within said interface;

(b) engaging said peripheral, via a capture mechanism, to enable said interface to measure manipulation of said peripheral;

(c) measuring manipulation of said captured peripheral via the sensing assembly; and

(d) transmitting information associated with the measured manipulation from the interface to the simulation system to simulate performance of the medical procedure with the corresponding medical instrument in accordance with the measured manipulation.

93. The method of claim 92 wherein said medical instrument includes an endoscope.

94. The method of claim 92 wherein said peripheral includes a nested instrument assembly, and step (b) further includes:

(b.1) engaging each instrument of said nested instrument assembly to enable said interface to measure manipulation of that instrument;

step (c) further includes:

(c.1) measuring manipulation of each said instrument of the nested instrument assembly; and

step (d) further includes:

(d.1) transmitting information associated with the measured manipulation of each said instrument of the nested instrument assembly from the interface to the simulation system to simulate performance of the medical procedure with the corresponding medical instrument in accordance with the measured nested instrument assembly manipulation.

B1 CONT.

95. The method of claim 92 wherein step (a) further includes:

(a.1) pivoting said orifice to a desired orientation.

96. The apparatus of claim 85 further including:

a coupling mechanism for receiving said peripheral from said orifice and operatively coupling said peripheral to said sensing assembly via said capture mechanism, wherein said coupling mechanism includes dimension adjustment means for automatically adjusting coupling mechanism dimensions in response to translational manipulation of said peripheral relative to said interface apparatus.

97. The apparatus of claim 85 wherein said sensing assembly includes:

a force feedback unit to apply force feedback to said peripheral in response to control signals from said simulation system.

98. The apparatus of claim 96 further including:

a mock anatomical site having said orifice for receiving said peripheral and providing access to said coupling mechanism; and

a pivoting mechanism to selectively pivot said mock anatomical site into a particular orientation to perform the medical procedure.

B1 CONT.

99. The apparatus of claim 96 further including:

a mock anatomical site having said orifice for receiving said peripheral;

a block of resilient material disposed between said mock anatomical site and said coupling mechanism; and

a guide tube extending from said orifice through said block to said coupling mechanism to guide said peripheral within said interface apparatus;

wherein said block provides resiliency to simulate forces and movement of said orifice encountered during performance of the medical procedure.

100. The apparatus of claim 99 wherein said resilient material includes foam.

101. The apparatus of claim 85 wherein said corresponding medical instrument includes an

endoscope, and said medical procedure is an endoscopic procedure.

102. The apparatus of claim 101 wherein said peripheral is in the form of an endoscope and includes:

a working channel;

a working channel peripheral selectively manipulable by the user and corresponding to a working channel tool; and

a sensor to measure manipulation of said working channel peripheral and transmit information associated with said working channel peripheral manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding working channel tool in accordance with said working channel peripheral manipulation.

B1 Cont.

103. The apparatus of claim 102 wherein said peripheral further includes a working channel force feedback unit to apply force feedback to said working channel peripheral.

104. The apparatus of claim 101 wherein said peripheral is in the form of an endoscope and includes:

a navigation tube for insertion into the interface apparatus to traverse the simulated anatomy of the virtual patient, wherein a distal end of said navigation tube corresponds to a medical tool;

a tube position control peripheral selectively manipulable by the user and associated with the distal end of said navigation tube; and

a sensor to measure manipulation of said tube position control peripheral and transmit information associated with said tube position control peripheral manipulation to the simulation system to enable the simulation system to simulate flexing of said navigation tube distal end and operation and positioning of said medical tool within the simulated anatomy during performance of the medical procedure in accordance with said tube position control peripheral manipulation.

105. The apparatus of claim 85 wherein:

said peripheral includes a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument;

said interface apparatus further includes a plurality of said capture mechanisms to engage said nested instruments; and

said sensing assembly includes peripheral sensing means for measuring manipulation of each captured nested instrument within the simulated anatomy and providing information associated with said nested instrument manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments in accordance with said nested instrument manipulation.

106. The apparatus of claim 85 further including a plurality of peripherals each selectively manipulable by the user and corresponding to a medical instrument and a plurality of said capture mechanisms to engage said plurality of peripherals;

wherein said sensing assembly includes peripheral sensing means for measuring manipulation and detecting insertion and removal of each peripheral within the simulated anatomy

and providing information associated with manipulation, insertion and removal of each said peripheral to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments and exchange of said corresponding medical instruments during the medical procedure in accordance with said manipulation, insertion and removal of said peripherals.

107. The apparatus of claim 96 further including a force feedback unit to apply force feedback to said peripheral in response to control signals from said simulation system.

B1 CONT.

108. The apparatus of claim 85 wherein said capture mechanism includes:

a grasping member for engaging said peripheral; and

an actuator for actuating said grasping member to engage said peripheral in response to manipulation of said peripheral into said grasping member.

109. The apparatus of claim 108 wherein said grasping member includes a tubular member to receive said peripheral, and said actuator includes:

a spring to elongate and compress said tubular member in response to translational manipulation of said peripheral relative to said interface apparatus to facilitate adjustment of tubular member cross-sectional dimensions;

wherein expansion of said spring in response to insertion of said peripheral within said interface apparatus elongates said tubular member, thereby decreasing said tubular member cross-sectional dimensions to engage said peripheral, and wherein compression of said spring in response

to withdrawal of said peripheral from said interface apparatus compresses said tubular member, thereby increasing said tubular member cross-sectional dimensions to release said peripheral.

110. The apparatus of claim 108 wherein:

said capture mechanism is disposed within said sensing assembly;

said grasping member includes a plurality of jaws defined in a distal portion thereof to surround and engage said peripheral; and

said actuator includes:

a spring disposed over said grasping member to bias said jaws to a normally closed state;

an expander disposed proximate said spring and having a conical distal end to manipulate said jaws to enter open and closed states; and

a pivotable actuator disposed proximate said expander to manipulate said expander to overcome said spring bias and control actuation of said jaws for entry into said closed and open states for capturing and releasing said peripheral.

B1 CONT.

111. The apparatus of claim 110 wherein said capture mechanism further includes:

an automatic capture and release mechanism to automatically actuate said jaws to capture and release said peripheral.

112. The apparatus of claim 111 wherein said automatic capture and release mechanism includes:

a rod connected to said sensing assembly via a friction bracket;

a pivotable bracket disposed on said sensing assembly proximate said rod;

an actuator extension coupled to said pivotable actuator to control actuation of said jaws to capture and release said peripheral;

a support bracket disposed on said rod for manipulating said actuator extension to control actuation of said jaws;

a bracket spring disposed between said sensing assembly and said pivotable bracket to apply force to said pivotable bracket to pivot that bracket about said support bracket and manipulate said actuator extension relative to said support bracket to control actuation of said jaws in response to insertion and withdrawal of said peripheral within said interface apparatus;

wherein said grasping member captures said peripheral in response to said actuator extension being forced against said support bracket by said pivotable bracket and said bracket spring and releases said peripheral in response to said actuator extension being forced away from said support bracket by said pivotable bracket and said bracket spring.

113. The apparatus of claim 112 wherein said peripheral includes a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument, and said interface apparatus further includes:

a plurality of said sensing assemblies, each including said capture mechanism and associated with a corresponding nested instrument for engaging and measuring manipulation of that nested instrument and providing information associated with manipulation of that nested instrument to the simulation system to enable the simulation system to simulate performance of the medical procedure

with said corresponding medical instruments in accordance with said nested instrument manipulation; and

wherein said friction bracket of each said sensing assembly capture mechanism includes a selectively adjustable friction member to adjust frictional forces between that friction bracket and a corresponding capture mechanism rod to control resistance applied by that sensing assembly to translational motion of said corresponding nested instrument;

wherein said friction member simulates frictional forces encountered between nested instruments during performance of the medical procedure.

B1 CONT.

114. The apparatus of claim 107 wherein:

said dimension adjustment means includes an inner tubular member and an outer tubular member, wherein said inner tubular member is disposed within said outer tubular member and slides relative to said outer tubular member to automatically adjust said coupling mechanism dimensions in response to translational manipulation of said peripheral relative to said interface apparatus;

said capture mechanism is disposed at a proximal end of said inner tubular member to engage said peripheral; and

a distal end of said inner tubular member is attached to said sensing assembly, wherein said inner tubular member is manipulated in accordance with said peripheral manipulation and said sensing assembly measures said peripheral manipulation by measuring manipulation of said inner tubular member.

115. The apparatus of claim 114 further including first and second supports, wherein said

sensing assembly includes:

first and second pulleys disposed on said first and second supports, respectively;

a belt disposed about and between said first and second pulleys;

a peripheral motion assembly attached to said belt and said inner tubular member distal end to facilitate measurement of manipulation of said inner tubular member to measure said peripheral manipulation, wherein said peripheral motion assembly is movable between said first and second supports in response to translational manipulation of said peripheral relative to said interface apparatus and further includes a rotation sensor to measure rotational motion of said peripheral by measuring rotational motion of said inner tubular member; and

a translation sensor disposed proximate said first pulley to measure translational motion of said peripheral by measuring rotation of said first pulley, wherein said peripheral motion assembly manipulates said belt to rotate said first and second pulleys during movement between said first and second supports in response to said translational manipulation of said peripheral;

wherein said force feedback unit is disposed proximate said second pulley to apply force feedback to said peripheral in response to control signals from said simulation system by controlling rotation of said second pulley, wherein said second pulley applies a force to said belt in response to said controlled rotation to control translational motion of said peripheral motion assembly, and thereby control translational motion of said peripheral.

116. The apparatus of claim 109 further including bias means for biasing said capture mechanism to an open state to enable entry and release of said peripheral within said capture mechanism.

117. The apparatus of claim 116 further including first and second supports and a coupling mechanism for receiving said peripheral from said orifice and operatively coupling said peripheral to said sensing assembly via said capture mechanism, wherein said sensing assembly is disposed between said first and second supports and said capture mechanism is disposed at a proximal end of said coupling mechanism, and wherein said bias means includes:

a first magnet attached to a distal portion of said coupling mechanism; and

a second magnet attached to said first support;

wherein attraction forces of said first and second magnets bias said spring to a compressed state to facilitate increased cross-sectional dimensions of said tubular member and entry and release of said peripheral within said capture mechanism.

B1 10 Cont.

118. The apparatus of claim 107 wherein said dimension adjustment means includes stabilization means for stabilizing said peripheral against buckling during manipulation of said peripheral within said interface apparatus to perform the medical procedure.

119. The apparatus of claim 118 wherein:

said stabilization means includes an inner tubular member and an outer tubular member, wherein said inner tubular member is disposed within said outer tubular member and slides relative to said outer tubular member to stabilize said peripheral against buckling and to automatically adjust said coupling mechanism dimensions in response to translational manipulation of said peripheral relative to said interface apparatus; and

a distal end of said inner tubular member is attached to said sensing assembly to operatively

couple said peripheral to said sensing assembly.

120. The apparatus of claim 118 further including first and second supports, wherein said sensing assembly includes:

first and second pulleys disposed on said first and second supports, respectively;

a belt disposed about and between said first and second pulleys;

a peripheral motion assembly attached to said belt and said stabilization means to facilitate measurement of said peripheral manipulation and including said capture mechanism to engage said peripheral, wherein said peripheral motion assembly is movable between said first and second supports in response to translational manipulation of said peripheral relative to said interface apparatus and further includes a rotation sensor to measure rotational motion of said peripheral; and

a translation sensor disposed proximate said first pulley to measure translational motion of said peripheral by measuring rotation of said first pulley, wherein said peripheral motion assembly manipulates said belt to rotate said first and second pulleys during movement between said first and second supports in response to said translational manipulation of said peripheral;

wherein said force feedback unit is disposed proximate said second pulley to apply force feedback to said peripheral in response to control signals from said simulation system by controlling rotation of said second pulley, wherein said second pulley applies a force to said belt in response to said controlled rotation to control translational motion of said peripheral motion assembly, and thereby control translational motion of said peripheral.

121. The apparatus of claim 118 wherein said dimension adjustment means includes a

bellows and said stabilization means includes a series of openings defined in said bellows for receiving said peripheral and operatively coupling said peripheral to said sensing assembly.

122. The apparatus of claim 118 further including first and second supports, wherein said sensing assembly includes:

first and second pulleys disposed adjacent said first and second supports, respectively;

a belt disposed about and between said first and second pulleys; and

a peripheral motion assembly attached to said belt and including said capture mechanism to engage said peripheral, wherein said coupling mechanism is disposed between said peripheral motion assembly and said first support, and wherein said peripheral motion assembly is movable between said first and second supports in response to translational manipulation of said peripheral relative to said interface apparatus and further includes:

a rotation sensor to measure rotational motion of said peripheral; and

a translation sensor to measure translational motion of said peripheral;

wherein said force feedback unit is disposed proximate said first pulley to apply force feedback to said peripheral in response to control signals from said simulation system by controlling rotation of said first pulley, wherein said first pulley applies a force to said belt in response to said controlled rotation to control translational motion of said peripheral motion assembly, and thereby control translational motion of said peripheral.

123. The apparatus of claim 118 wherein said peripheral includes a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument, and

said interface apparatus further includes:

first and second supports;

a plurality of said sensing assemblies, each associated with a corresponding nested instrument for measuring manipulation of that nested instrument within the simulated anatomy and providing information associated with manipulation of that nested instrument to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments in accordance with said nested instrument manipulation;

a plurality of said coupling mechanisms each associated with a corresponding nested instrument for stabilizing said corresponding nested instrument against buckling and operatively coupling said corresponding nested instrument to a corresponding sensing assembly, wherein each said sensing assembly includes:

B1 CONT.

first and second pulleys disposed toward said first and second supports, respectively;

a belt disposed about and between said first and second pulleys;

a peripheral motion assembly attached to said belt and including said capture mechanism to engage a corresponding nested instrument, wherein said peripheral motion assembly is movable between said first and second supports in response to translational manipulation of said corresponding nested instrument relative to said interface apparatus and further includes:

a rotation sensor to measure rotational motion of said corresponding nested instrument; and

a translation sensor to measure translational motion of said corresponding nested instrument; and

a force feedback unit disposed proximate said first pulley to apply force feedback to said corresponding nested instrument in response to control signals from said simulation system by controlling rotation of said first pulley, wherein said first pulley applies a force to said belt in response to said controlled rotation to control translational motion of said peripheral motion assembly, and thereby control translational motion of said corresponding nested instrument;

wherein said peripheral motion assemblies are successively arranged between said first and second supports, and wherein each said capture mechanism is configured to capture a nested instrument of a particular dimension and permit lesser dimensioned instruments to extend through that peripheral motion assembly.

B1 cont.

124. The apparatus of claim 118 further including:

first and second supports;

a plurality of independent peripherals each selectively manipulable by the user and corresponding to a medical instrument;

a plurality of said sensing assemblies each associated with a corresponding independent peripheral for measuring manipulation of said corresponding independent peripheral within the simulated anatomy and providing information associated with manipulation of that independent peripheral to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments in accordance with said independent peripheral manipulation;

a plurality of said coupling mechanisms each associated with a corresponding independent

peripheral for stabilizing said corresponding independent peripheral against buckling and operatively coupling said corresponding independent peripheral to a corresponding sensing assembly, wherein each said sensing assembly includes:

first and second pulleys disposed toward said first and second supports, respectively;

a belt disposed about and between said first and second pulleys;

a peripheral motion assembly attached to said belt and including said capture mechanism to engage said corresponding independent peripheral, wherein said peripheral motion assembly is movable between said first and second supports in response to translational manipulation of said corresponding independent peripheral relative to said interface apparatus and further includes:

a rotation sensor to measure rotational motion of said corresponding independent peripheral; and

a translation sensor to measure translational motion of said corresponding independent peripheral; and

a force feedback unit disposed proximate said first pulley to apply force feedback to said corresponding independent peripheral in response to control signals from said simulation system by controlling rotation of said first pulley, wherein said first pulley applies a force to said belt in response to said controlled rotation to control translational motion of said peripheral motion assembly, and thereby control translational motion of said corresponding independent peripheral;

wherein said sensing assemblies are arranged in parallel relation within said interface apparatus to measure manipulation of said independent peripherals.

125. The apparatus of claim 124 wherein:

at least one of said independent peripherals includes a plurality of nested instruments with each nested instrument being selectively manipulable by the user and corresponding to a medical instrument;

a plurality of said sensing assemblies are associated with said at least one nested peripheral, wherein each nested peripheral sensing assembly is associated with a corresponding nested instrument to engage, provide force feedback to and measure manipulation of that nested instrument; and

a plurality of said coupling mechanisms are associated with said at least one nested peripheral with each associated coupling mechanism stabilizing a corresponding nested instrument against buckling and operatively coupling said corresponding nested instrument to a corresponding sensing assembly.

126. The apparatus of claim 124 further including:

a mock anatomical site having a plurality of said orifices, wherein each said orifice is associated with a corresponding independent peripheral for receiving that peripheral;

a block of resilient material disposed between said mock anatomical site and said coupling mechanisms; and

a plurality of guide tubes each associated with a corresponding orifice and extending from that orifice through said block to a corresponding coupling mechanism to guide said independent peripheral associated with that orifice within said interface apparatus;

wherein said block provides resiliency to simulate forces and movement of said orifices

encountered during performance of the medical procedure.

127. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a plurality of peripherals each selectively manipulable by the user and corresponding to a medical instrument; and

a plurality of sensing assemblies each associated with a corresponding peripheral for measuring manipulation and detecting insertion and removal of that peripheral within the simulated anatomy and providing information associated with manipulation, insertion and removal of said corresponding peripheral to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments and exchange of said corresponding medical instruments during the medical procedure in accordance with said manipulation, insertion and removal of said peripherals.

B1 cont.

128. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral selectively manipulable by the user and corresponding to a medical instrument;

a sensing assembly to measure manipulation of said peripheral and transmit information

associated with said manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation;

a mock anatomical site having an orifice for receiving said peripheral and providing access to said sensing assembly; and

a pivoting mechanism to selectively pivot said mock anatomical site into a particular orientation to perform the medical procedure.

B1 CONT'

129. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral selectively manipulable by the user and corresponding to a medical instrument;

a sensing assembly to measure manipulation of said peripheral and transmit information associated with said manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation;

a mock anatomical site having an orifice for receiving said peripheral and providing access to said sensing assembly;

a block of resilient material disposed between said mock anatomical site and said sensing assembly; and

a guide tube extending from said orifice through said block toward said sensing assembly to

guide said peripheral within said interface apparatus;

wherein said block provides resiliency to simulate forces and movement of said orifice encountered during performance of the medical procedure.

130. The apparatus of claim 129 wherein said resilient material includes foam.

131. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral having a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument;

a plurality of sensing assemblies each associated with a corresponding nested instrument for measuring manipulation of said corresponding nested instrument within the simulated anatomy and providing information associated with manipulation of that nested instrument to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments in accordance with said nested instrument manipulation;

wherein each said sensing assembly includes a peripheral motion assembly including a capture mechanism to engage said corresponding nested instrument, and said peripheral motion assembly is movable in response to translational manipulation of said corresponding nested instrument relative to said interface apparatus and further includes:

a rotation sensor to measure rotational motion of said corresponding nested

instrument; and

a translation sensor to measure translational motion of said corresponding nested instrument;

wherein said peripheral motion assemblies are successively arranged, and wherein each said capture mechanism is configured to capture a nested instrument of a particular dimension and permit lesser dimensioned instruments to extend through that peripheral motion assembly.

132. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a plurality of independent peripherals each selectively manipulable by the user and corresponding to a medical instrument;

a plurality of sensing assemblies each associated with a corresponding independent peripheral for measuring manipulation of said corresponding independent peripheral within the simulated anatomy and providing information associated with manipulation of that independent peripheral to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instruments in accordance with said independent peripheral manipulation;

wherein each said sensing assembly includes a peripheral motion assembly including a capture mechanism to engage said corresponding independent peripheral, and said peripheral motion assembly is movable in response to translational manipulation of said corresponding independent

peripheral relative to said interface apparatus and further includes:

a rotation sensor to measure rotational motion of said corresponding independent peripheral; and

a translation sensor to measure translational motion of said corresponding independent peripheral;

wherein said sensing assemblies are arranged in parallel relation within said interface apparatus to measure manipulation of said independent peripherals.

133. The mechanism of claim 91 wherein said grasping member includes a tubular member disposed between proximal and distal ends of said capture mechanism for engaging said peripheral, and said actuator includes:

a spring disposed between said proximal and distal ends of said capture mechanism and over said tubular member to elongate and compress said tubular member in response to translational manipulation of said peripheral relative to said interface apparatus to facilitate adjustment of tubular member cross-sectional dimensions;

wherein expansion of said spring in response to insertion of said peripheral within said interface apparatus elongates said tubular member, thereby decreasing said tubular member cross-sectional dimensions to engage said peripheral, and wherein compression of said spring in response to withdrawal of said peripheral from said interface apparatus compresses said tubular member, thereby increasing said tubular member cross-sectional dimensions to release said peripheral.

134. The mechanism of claim 133 further including:

a disc attached to a distal end of said capture mechanism;

a first annular washer disposed proximate and connected to said disc;

a second annular washer disposed toward said proximal end of said capture mechanism; and

a third annular washer disposed proximally of and connected to said second annular washer for receiving said peripheral;

wherein a tubular member distal end is disposed through said first annular washer and attached to said disc and a tubular member proximal end is disposed through said second annular washer and attached to said third annular washer;

wherein said spring is disposed between said first and second annular washers to elongate and compress said tubular member in response to translational manipulation of said peripheral relative to said interface apparatus to facilitate adjustment of tubular member cross-sectional dimensions.

135. The mechanism of claim 133 wherein said tubular member includes a spirally wound material.

136. The mechanism of claim 91 wherein said grasping member includes a plurality of jaws defined in a distal portion thereof to surround and engage said peripheral, and said actuator includes:

a spring disposed over said grasping member to bias said jaws to a normally closed state;

an expander disposed proximate said spring and having a conical distal end to manipulate said jaws to enter open and closed states; and

a pivotable actuator disposed proximate said expander to manipulate said expander to

overcome said spring bias and control actuation of said jaws for entry into said closed and open states for capturing and releasing said peripheral.

137. The mechanism of claim 136 further including an automatic capture and release mechanism to automatically actuate said jaws to capture and release said peripheral.

138. The mechanism of claim 137 wherein said automatic capture and release mechanism includes:

B1 cont.

a rod connected to said sensing assembly via a friction bracket;

a pivotable bracket disposed on said sensing assembly proximate said rod;

an actuator extension coupled to said pivotable actuator to control actuation of said jaws to capture and release said peripheral;

a support bracket disposed on said rod for manipulating said actuator extension to control actuation of said jaws;

a bracket spring disposed between said sensing assembly and said pivotable bracket to apply force to said pivotable bracket to pivot that bracket about said support bracket and manipulate said actuator extension relative to said support bracket to control actuation of said jaws in response to insertion and withdrawal of said peripheral within said interface apparatus;

wherein said grasping member captures said peripheral in response to said actuator extension being forced against said support bracket by said pivotable bracket and said bracket spring and releases said peripheral in response to said actuator extension being forced away from said support bracket by said pivotable bracket and said bracket spring.

139. The method of claim 92 wherein step (b) further includes:

(b.1) operatively coupling the peripheral to the sensing assembly via a coupling mechanism; and

(b.2) automatically adjusting coupling mechanism dimensions in response to translational manipulation of the peripheral relative to the interface to facilitate measurement of peripheral manipulation.

B1 CONT

140. The method of claim 92 further including the step of:

(e) applying force feedback to the peripheral in response to control signals from the simulation system.

141. The method of claim 139 wherein the interface further includes a mock anatomical site having said orifice for receiving the peripheral and providing access to the coupling mechanism, and step (a) further includes:

(a.1) selectively pivoting the mock anatomical site into a particular orientation to perform the medical procedure.

142. The method of claim 139 wherein the interface further includes a mock anatomical site having said orifice for receiving the peripheral, a block of resilient material disposed between the mock anatomical site and the coupling mechanism and a guide tube to guide the peripheral within the interface, and step (a) further includes:

(a.1) simulating forces and movement of the orifice encountered during performance of the

medical procedure by forming a resilient passage within the interface for the peripheral to traverse, wherein step (a.1) further includes:

(a.1.1) forming the resilient passage by positioning the guide tube within the interface to extend from the orifice through the block to the coupling mechanism.

143. The method of claim 92 wherein the corresponding medical instrument includes an endoscope, and the medical procedure is an endoscopic procedure.

144. The method of claim 143 wherein the peripheral is in the form of an endoscope and includes a working channel, a working channel peripheral selectively manipulable by the user and corresponding to a working channel tool and a sensor to measure manipulation of the working channel peripheral, and step (c) further includes:

(c.1) measuring manipulation of the working channel peripheral via the sensor; and

step (d) further includes:

(d.1) transmitting information associated with the working channel peripheral manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding working channel tool in accordance with the working channel peripheral manipulation.

145. The method of claim 144 further including the step of:

(e) applying force feedback to the working channel peripheral.

146. The method of claim 143 wherein the peripheral is in the form of an endoscope and includes a navigation tube for insertion into the interface to traverse the simulated anatomy of the virtual patient, a tube position control peripheral selectively manipulable by the user and associated with a distal end of the navigation tube and a sensor to measure manipulation of the tube position peripheral, wherein the distal end of the navigation tube corresponds to a medical tool, and step (c) further includes:

(c.1) measuring manipulation of the tube position control peripheral via the sensor; and

step (d) further includes:

(d.1) transmitting information associated with the tube position control peripheral manipulation to the simulation system to enable the simulation system to simulate flexing of the navigation tube distal end and operation and positioning of the medical tool within the simulated anatomy during performance of the medical procedure in accordance with the tube position control peripheral manipulation.

147. The method of claim 92 wherein the peripheral includes a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument, the interface further includes a plurality of said capture mechanisms each associated with a corresponding nested instrument, and step (b) further includes:

(b.1) engaging the nested instruments via the capture mechanisms;

step (c) further includes:

(c.1) measuring manipulation of each captured instrument within the simulated anatomy via the sensing assembly; and

step (d) further includes:

(d.1) transmitting information associated with the measured nested instrument manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instruments in accordance with the nested instrument manipulation.

148. The method of claim 92 wherein the interface further includes a plurality of peripherals each selectively manipulable by the user and corresponding to a medical instrument and a plurality of said capture mechanisms each associated with a corresponding peripheral, and step (b) further includes:

(b.1) engaging the plurality of peripherals via the capture mechanisms;

step (c) further includes:

(c.1) measuring manipulation and detecting insertion and removal of each peripheral within the simulated anatomy via the sensing assembly; and

step (d) further includes:

(d.1) transmitting information associated with the manipulation, insertion and removal of each peripheral to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instruments and exchange of the corresponding medical instruments during the medical procedure in accordance with the manipulation, insertion and removal of the peripherals.

149. The method of claim 139 further including the step of:

(e) applying force feedback to the peripheral in response to control signals from the simulation system.

150. The method of claim 92 wherein the capture mechanism includes a grasping member and an actuator, and step (b) further includes:

(b.1) actuating said grasping member via the actuator to engage the peripheral in response to manipulation of the peripheral into the grasping member.

B1 cont'd

151. The method of claim 150 wherein the grasping member includes a tubular member disposed between proximal and distal ends of the capture mechanism, and the actuator includes a spring disposed over the tubular member to elongate and compress the tubular member, and wherein step (b.1) further includes:

(b.1.1) decreasing cross-sectional dimensions of the tubular member to engage the peripheral by expanding the spring in response to insertion of the peripheral within the interface; and

(b.1.2) increasing the tubular member cross-sectional dimensions to release the peripheral by compressing the spring in response to withdrawal of the peripheral from the interface.

152. The method of claim 150 wherein the capture mechanism is disposed within the sensing assembly, said grasping member includes a plurality of jaws defined in a distal portion thereof to surround and engage the peripheral, and said actuator includes a spring disposed over the grasping member, an expander having a conical distal end to manipulate the jaws, and a pivotable actuator to manipulate the expander to actuate the jaws, wherein step (b.1) further includes:

(b.1.1) biasing the jaws to a normally closed state via the spring; and

(b.1.2) manipulating the jaws to enter open and closed states for capturing and releasing the peripheral by manipulating the pivotable actuator to cause the expander to overcome the spring bias and control actuation of the jaws.

153. The method of claim 152 wherein the capture mechanism further includes an automatic capture and release mechanism, and step (b.1.2) further includes:

(b.1.2.1) automatically actuating the jaws to capture and release the peripheral via the automatic capture and release mechanism.

B1 Cont.

154. The method of claim 153 wherein the automatic capture and release mechanism includes a rod connected to the sensing assembly via a friction bracket, a pivotable bracket disposed on the sensing assembly proximate the rod, an actuator extension coupled to the pivotable actuator to control actuation of the jaws, a support bracket disposed on the rod and a bracket spring disposed between the sensing assembly and the pivotable bracket, and step (b.1.2.1) further includes:

(b.1.2.1.1) pivoting the pivotable bracket about the support bracket to manipulate the actuator extension relative to the support bracket to control actuation of the jaws in response to insertion and withdrawal of the peripheral within the interface;

(b.1.2.1.2) capturing the peripheral in response to the actuator extension being forced against the support bracket during insertion of the peripheral within the interface; and

(b.1.2.1.3) releasing the peripheral in response to the actuator extension being forced away from the support bracket during withdrawal of the peripheral from the interface.

155. The method of claim 154 wherein the peripheral includes a plurality of nested instruments each selectively manipulable by the user and corresponding to a medical instrument, the interface further includes a plurality of said sensing assemblies each including said capture mechanism and associated with a corresponding nested instrument to measure manipulation of that nested instrument, and wherein the friction bracket of each sensing assembly capture mechanism includes a selectively adjustable friction member, and step (b) further includes:

(b.2) engaging the nested instruments via the corresponding capture mechanisms;

step (c) further includes:

(c.1) measuring manipulation of each nested instrument via the corresponding sensing assemblies; and

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step (d) further includes:

(d.1) transmitting information associated with manipulation of the nested instruments to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instruments in accordance with the nested instrument manipulation; and

(d.2) simulating frictional forces encountered between nested instruments during performance of the medical procedure by adjusting frictional forces between the friction bracket of each sensing assembly and a corresponding capture mechanism rod to control resistance applied by that sensing assembly to translational motion of the corresponding nested instrument.

156. The method of claim 149 wherein the coupling mechanism includes an inner tubular member disposed within an outer tubular member, the capture mechanism is disposed at a proximal

end of the inner tubular member to engage the peripheral, a distal end of the inner tubular member is attached to the sensing assembly, and step (b.2) further includes:

(b.2.1) automatically adjusting the coupling mechanism dimensions in response to translational manipulation of the peripheral relative to the interface by sliding the inner tubular member relative to the outer tubular member; and

step (c) further includes:

(c.1) measuring manipulation of the peripheral by measuring manipulation of the inner tubular member, wherein the inner tubular member is manipulated in accordance with manipulation of the peripheral.

B1 cont'

157. The method of claim 149 wherein step (b) further includes:

(b.3) biasing the capture mechanism to an open state to enable entry and release of the peripheral within the capture mechanism.

158. The method of claim 149 wherein step (b.2) further includes:

(b.2.1) stabilizing the peripheral against buckling during manipulation of the peripheral within the interface to perform the medical procedure.

159. The method of claim 158 wherein the coupling mechanism includes an inner tubular member disposed within an outer tubular and a distal end of the inner tubular member is attached to the sensing assembly, and step (b.2.1) further includes:

(b.2.1.1) stabilizing the peripheral against buckling and automatically adjusting the coupling

mechanism dimensions in response to translational manipulation of the peripheral relative to the interface by sliding the inner tubular member relative to the outer tubular member.

160. The method of claim 149 wherein the interface further includes first and second supports, the sensing assembly includes first and second pulleys respectively disposed on the first and second supports, a belt disposed about and between the first and second pulleys and a peripheral motion assembly attached to the belt and coupled to the peripheral, wherein the peripheral motion assembly is movable between the first and second supports in response to translational manipulation of the peripheral relative to the interface, and step (c) further includes:

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(c.1) measuring rotational motion of the peripheral; and

(c.2) measuring translational motion of the peripheral by measuring rotation of the first pulley, wherein the peripheral motion assembly manipulates the belt to rotate the first and second pulleys during movement between the first and second supports in response to translational manipulation of the peripheral; and

step (e) further includes:

(e.1) applying force feedback to the peripheral in response to control signals from the simulation system by controlling rotation of the second pulley, wherein the second pulley applies a force to the belt in response to the controlled rotation to control translational motion of the peripheral motion assembly, and thereby control translational motion of the peripheral.

161. The method of claim 149 wherein the interface further includes first and second supports, the sensing assembly includes first and second pulleys respectively disposed adjacent the

first and second supports, a belt disposed about and between the first and second pulleys and a peripheral motion assembly attached to the belt and coupled to the peripheral, wherein the peripheral motion assembly is movable between the first and second supports in response to translational manipulation of the peripheral relative to the interface, and step (c) further includes:

(c.1) measuring rotational motion of the peripheral; and

(c.2) measuring translational motion of the peripheral by measuring translational motion of the peripheral motion assembly, wherein the peripheral motion assembly manipulates the belt to rotate the first and second pulleys during movement between the first and second supports in response to translational manipulation of the peripheral; and

step (e) further includes:

(e.1) applying force feedback to the peripheral in response to control signals from the simulation system by controlling rotation of the first pulley, wherein the first pulley applies a force to the belt in response to the controlled rotation to control translational motion of the peripheral motion assembly, and thereby control translational motion of the peripheral.

162. The method of claim 158 wherein the coupling mechanism includes a bellows with a series of openings defined therein, and step (b.2.1) further includes:

(b.2.1.1) stabilizing the peripheral against buckling by disposing the peripheral through the openings to operatively couple the peripheral to the sensing assembly.

163. In an interface having a plurality of peripherals each selectively manipulable by a user and corresponding to a medical instrument and a plurality of sensing assemblies each associated with

a corresponding peripheral for measuring manipulation of that peripheral, a method of enabling the user to interact with a simulation system via the interface to perform a medical procedure on a simulated anatomy of a virtual patient comprising the steps of:

(a) operatively coupling the peripherals to the corresponding sensing assemblies;

(b) measuring manipulation and detecting insertion and removal of each peripheral within the simulated anatomy via the corresponding sensing assemblies; and

(c) transmitting information associated with the manipulation, insertion and removal of the peripherals from the interface to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instruments and exchange of the corresponding medical instruments during the medical procedure in accordance with the manipulation, insertion and removal of the peripherals.

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164. In an interface having a peripheral selectively manipulable by a user and corresponding to a medical instrument, a sensing assembly to measure manipulation of the peripheral and a mock anatomical site having an orifice for receiving the peripheral and providing access to the sensing assembly, a method of enabling the user to interact with a simulation system via the interface to perform a medical procedure on a simulated anatomy of a virtual patient comprising the steps of:

(a) operatively coupling the peripheral to the sensing assembly;

(b) selectively pivoting the mock anatomical site into a particular orientation to perform the medical procedure;

(c) measuring manipulation of the peripheral via the sensing assembly; and

(d) transmitting information associated with the measured manipulation from the interface

to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instrument in accordance with the peripheral manipulation.

165. In an interface having a peripheral selectively manipulable by a user and corresponding to a medical instrument, a sensing assembly to measure manipulation of the peripheral, a mock anatomical site having an orifice for receiving the peripheral, a block of resilient material disposed between the mock anatomical site and the sensing assembly and a guide tube to guide the peripheral within the interface, a method of enabling the user to interact with a simulation system via the interface to perform a medical procedure on a simulated anatomy of a virtual patient comprising the steps of:

(a) operatively coupling the peripheral to the sensing assembly;

(b) simulating forces and movement of the orifice encountered during performance of the medical procedure by forming a resilient passage within the interface for the peripheral to traverse, wherein step (b) further includes:

(b.1) forming the resilient passage by positioning the guide tube within the interface to extend from the orifice through the block toward the sensing assembly;

(c) measuring manipulation of the peripheral via the sensing assembly; and

(d) transmitting information associated with the measured manipulation from the interface to the simulation system to enable the simulation system to simulate performance of the medical procedure with the corresponding medical instrument in accordance with the peripheral manipulation.

166. In an interface for operatively interconnecting a peripheral to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, wherein the interface includes a sensing assembly to measure manipulation of the peripheral and transmit information associated with the manipulation to the simulation system, a coupling mechanism to operatively couple the peripheral to the sensing assembly and a capture mechanism having a grasping member and an actuator, a method of engaging the peripheral for interaction with the interface comprising the step of:

(a) actuating said grasping member via the actuator to engage the peripheral in response to manipulation of the peripheral into the grasping member.

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167. The method of claim 166 wherein said grasping member includes a tubular member and step (a) further includes:

(a.1) decreasing cross-sectional dimensions of the tubular member to engage the peripheral by expanding the tubular member in response to insertion of the peripheral within the interface; and

(a.2) increasing the tubular member cross-sectional dimensions to release the peripheral by compressing the tubular member in response to withdrawal of the peripheral from the interface.

168. The method of claim 166 wherein said grasping member includes a plurality of jaws defined in a distal portion thereof to surround and engage the peripheral, and said actuator includes a spring disposed over the grasping member to bias the jaws to a normally closed position, an expander to manipulate the jaws and a pivotable actuator to manipulate the expander to actuate the jaws to engage the peripheral, and wherein step (a) further includes:

(a.1) actuating the jaws to enter open and closed states for capturing and releasing the peripheral by manipulating the pivotable actuator to cause the expander to overcome the spring bias and control actuation of the jaws.

169. The method of claim 168 wherein the capture mechanism further includes an automatic capture and release mechanism, and step (a.1) further includes:

(a.1.1) automatically actuating the jaws to capture and release the peripheral via the automatic capture and release mechanism.

B1 cont.

170. The method of claim 169 wherein the automatic capture and release mechanism includes a rod connected to the sensing assembly via a friction bracket, a pivotable bracket disposed on the sensing assembly proximate the rod, an actuator extension coupled to the pivotable actuator to control actuation of the jaws, a support bracket disposed on the rod and a bracket spring disposed between the sensing assembly and pivotable bracket, and step (a.1.1) further includes:

(a.1.1.1) pivoting the pivotable bracket about the support bracket to manipulate the actuator extension relative to the support bracket to control actuation of the jaws in response to insertion and withdrawal of the peripheral within the interface apparatus;

(a.1.1.2) capturing the peripheral in response to the actuator extension being forced against the support bracket during insertion of the peripheral within the interface; and

(a.1.1.3) releasing the peripheral in response to the actuator extension being forced away from the support bracket during withdrawal of the peripheral from the interface.

171. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral selectively manipulable by the user and corresponding to a medical instrument;

a sensing assembly to measure manipulation of said peripheral and transmit information associated with said manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation; and

a coupling mechanism for receiving said peripheral and operatively coupling said peripheral to said sensing assembly, wherein said coupling mechanism includes an inner tubular member disposed within an outer tubular member, and wherein said inner tubular member is connected to said sensing assembly and slides relative to said outer tubular member in response to translational manipulation of said peripheral to stabilize said peripheral against buckling.

B1 cont'd

172. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral selectively manipulable by the user and corresponding to a medical instrument;

a sensing assembly to measure manipulation of said peripheral and transmit information associated with said manipulation to the simulation system to enable the simulation system to

simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation; and

a coupling mechanism for operatively coupling said peripheral to said sensing assembly and including a bellows having a series of openings defined therein, wherein said peripheral is disposed through said openings to stabilize said peripheral against buckling during user manipulation of said peripheral.

173. An interface apparatus for operatively interconnecting peripherals corresponding to medical instruments to a simulation system to enable a user to interact with the simulation system to perform a medical procedure on a simulated anatomy of a virtual patient, said interface apparatus comprising:

a peripheral selectively manipulable by the user and corresponding to a medical instrument;

a sensing assembly to measure manipulation of said peripheral and transmit information associated with said manipulation to the simulation system to enable the simulation system to simulate performance of the medical procedure with said corresponding medical instrument in accordance with said measured manipulation; and

a coupling mechanism for receiving said peripheral and operatively coupling said peripheral to said sensing assembly;

wherein said coupling mechanism includes a tubular member having a slit with dimensions less than the peripheral dimensions and said sensing assembly extends into said tubular member through said slit to engage said peripheral;

wherein said slit maintains said peripheral within said tubular member to stabilize said